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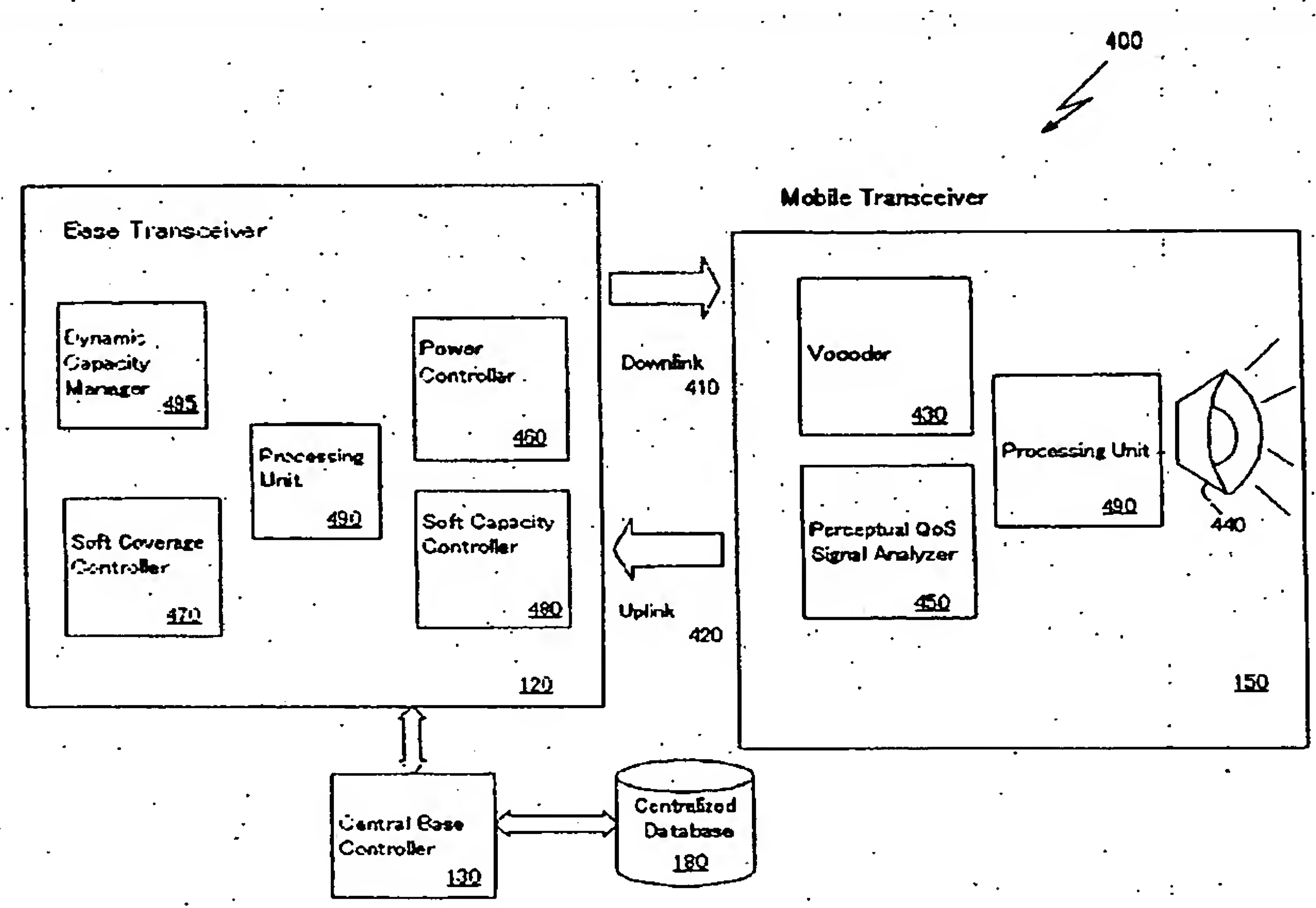

(57) Abstract: A system and method for billing customers of a cellular network according to the desired perceptual quality of service (QoS) is described. A cellular network is segmented into a plurality of classifications, wherein each classification is associated with the wireless devices that subscribe to the cellular network. The classifications define the conditions for admittance onto the network, as well as, the perceptual QoS to be provided to the wireless device once admitted. In particular, each classification indicates an expected perceptual QoS level of a voice signal that is transmitted to an associated wireless device. Customers are billed a higher rate for a higher level of perceptual QoS. Based on this expected quality level, the network dynamically adjusts the transmission parameters of each connection to maintain the expected quality level for a wireless device connected with the network.

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DESCRIPTION

METHOD AND APPARATUS FOR QUALITY BILLING

(Technical Field)

The present invention relates to wireless communications over a cellular network, and more particularly to linking the billing of network services to the perceptual quality of service (QoS), and enhanced call admission protocols based upon a plurality of available perceptual QoS levels.

(Background Art)

Wireless communications networks are becoming increasingly popular in our society as the rapid and accurate exchange of information is important to our economy. To many business people, wireless telephones have become an essential communications tool necessary in the performance of their jobs. Furthermore, increasing numbers of people have purchased wireless telephone and associated calling plans for personal use.

In many areas of the country and the world, the cells of wireless networks perform at or near full capacity at certain times of the day as large numbers of network users try to connect and use the network

simultaneously. While a network is operating near or at capacity maximizes the revenue generation of a wireless network provider, the quality decreases. When the quality decreases, the likelihood that users of the system will not use their wireless telephones as frequently or that they may switch to another network provider increases.

Given the relative importance of business calls versus personal calls, business people are generally less tolerant of poor perceptual quality of service (QoS) from a wireless network provider. Accordingly, they are the most likely to reduce their use of a wireless network due to poor quality; however, they are also the most likely to be willing to pay a premium for service if a high quality of service can be maintained. Conversely, personal users of wireless networks generally tend to be more tolerant of poor quality of service if the price of a calling plan is low enough.

The new 3G W-CDMA (code division multiple access) systems include specifications for a voice coder called Adaptive Multi Rate (AMR). AMR is adaptive because it can adapt to channel quality conditions. It is also Multi Rate, because it includes a set of bit-rates for the speech coder and the error-control coder. The basic

principle of AMR is simple: if the channel is poor, AMR can use higher error-control-coding bit rates. The flexibility of AMR provides a 3G operator with the ability to offer different classes of billing. 3G networks can, therefore, be run more efficiently if customers had the opportunity to choose from a variety of billing schemes that are tailored to provide wireless telephone users with different perceptual QoS levels wherein the higher quality of service plans are more costly than the lower quality of service plans.

Although the ability to utilize different voice signal compression levels is provided in W-CDMA and CDMA2000 networks, the prior art does not provide a means for adjusting the encoding compression levels dynamically to improve perceptual QoS. Rather, the art suggests only that the vocoder compression level be set at the beginning of a network connection based on a user's service plan.

Currently, there does not exist a means to provide customers with a variety service plans based upon the perceptual QoS of voice signals and to admit calls to a network according to the user profile. By applying the principles of the present invention, customers of a network can receive more tailored service. If a customer

desires a high quality of service, that customer may subscribe to the higher quality service for a premium. Likewise, if a customer does not have a need for a high level of network service, that customer may subscribe to a service that corresponds to a lower billing rate. Thus, it would be an improvement over the prior art to provide customers with a variety of billing schemes based upon the perceptual QoS and to admit calls to a network according to the user profile.

There is, therefore, a present need to provide an improved system and method for providing improved billing schemes for revenue enhancement and customer satisfaction based upon the enhanced signaling protocols and adaptive voice coders that allow quality-based billing in 3G networks

It is, accordingly, an object of the present invention to set forth an improved system and method that increases network efficiency and customer satisfaction.

It is, therefore, an object of the invention to provide customers with a variety of service plans based upon perceptual QoS and to admit calls to a network according to the user profile and available network resources.

It is a further object of the invention to provide customers of a cellular network with a variety of service and billing plans based upon their desired level of perceptual QoS.

It is a further object of the present invention to implement a hierarchy of service plans where the premium service plan provides a higher level of perceptual QoS.

It is a further object of the present invention to charge a higher billing rate for premium service plans.

In accordance with another aspect of the invention, it is a further object of the present invention to allocate specific resources of a network to the various service levels

It is a further object of the present invention to dynamically adjust the parameters and resources of the various service levels within the network based upon resources of the entire network.

It is a further object of the present invention to allocate the network resources of one service level to another service level in order to compensate for the increasing or decreasing demand of the network services within the various service levels.

In accordance with another aspect of the invention, it is a further object of the present invention to block

call admission to a network based upon available resources within the network.

It is a further object of the present invention to give priority to admission requests that originate from users that subscribe to a premium service plan.

Finally, it is a further object of the present invention to block call admission to a network based upon resource availability from allocated resources for that subscriber's service plan.

(Disclosure of Invention)

A system and method for billing customers based upon the perceptual quality of service (QoS) and admitting calls to a network according to the user profile and available network resources is disclosed. Customers of the communication network pay a premium for service that delivers a higher perceptual QoS. The transmission capacity of a base station transceiver within a cell of a cellular network is segmented into a plurality of categories. At least one of the categories is associated with a first perceptual quality of service (QoS) level, wherein the perceptual QoS levels define parameters for making connections between a wireless device and the base station transceiver. The perceptual QoS levels are also

associated with wireless devices. When a request to establish a connection with the base station is received from the wireless device, the base station transceiver provides transmission capacity to the wireless device from the category that is associated with the same perceptual QoS level as the wireless device. The transmission capacity may be dynamically reallocated among the various categories based on the capacity requirements of each category.

In another aspect of the invention, a wireless communications device is assigned a perceptual quality of service (QoS) level from a number of perceptual QoS levels. Each perceptual QoS level corresponds to different levels of perceptual QoS a user may subscribe to in a cellular network. A request is received to establish communications between a base transceiver within a cell of the cellular network and the wireless device. A determination is made whether to establish a connection based on the availability of unused capacity within the cell that is associated with the wireless device's perceptual QoS level. The connection is blocked if sufficient unused capacity is not available and admitted if sufficient capacity is available.

Advantageously, wireless network providers can offer differing service plans based on a user's particular perceptual QoS needs, wherein users requiring the best possible service pay more than users who are willing to sacrifice quality for reduced cost. Network providers can dynamically allocate limited network resources by adjusting transmission parameters in real time to maximize the revenue generating potential of the network while maintaining a perceptual QoS level that is satisfactory to the users of the network.

A more complete appreciation of the present invention and the scope thereof can be obtained from the accompanying drawings which are briefly summarized below in the following detailed description of the presently-preferred embodiments of the invention and the appended claims.

(Brief Description of Drawings)

The objects, features and advantages of the present invention are readily apparent from the detailed description of the preferred embodiments set forth below, in conjunction with the accompanying Drawings in which:

FIGURE 1 is a generalized illustration of a wireless cellular network;

FIGURE 2 graphically represents how the real time perceptual QoS level of a CDMA voice transmission may vary over time;

FIGURE 3 graphically illustrates voice signals of three classifications of service based on the perceptual QoS of the voice signal;

FIGURE 4 is a block diagram of a base transceiver and a mobile transceiver in communication over a wireless network according to one embodiment of the present invention;

FIGURE 5 is a flow diagram illustrating a method for adaptively adjusting transmission protocols for a network device based on perceptual QoS metrics;

FIGURE 6 illustrates in a graphical format how a signal can be adjusted to a selected level according to embodiments of the present invention;

FIGURE 7 graphically illustrates how the transmission rate of a voice signal may vary during a call according to an embodiment of the present invention;

FIGURE 8 graphically illustrates how the capacity of a cell may be divided among different classifications of service;

FIGURE 9 is a flow chart showing a call admittance algorithm for a call associated with an executive classification service plan;

FIGURE 10 is a flow chart showing a call admittance algorithm for a call associated with a standard classification service plan; and

FIGURE 11 is a flow chart showing a call admittance algorithm for a call associated with an economy classification service plan.

(Best Mode for Carrying Out the Invention)

The following detailed description is presented to enable any person skilled in the art to make and use the invention. For purposes of explanation, specific nomenclature is set forth to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that these specific details are not required to practice the invention. Descriptions of specific applications are provided only as representative examples. Various modifications to the preferred embodiments will be readily apparent to one skilled in the art, and the general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope

of the invention. The present invention is not intended to be limited to the embodiments shown, but is to be accorded the widest possible scope consistent with the principles and features disclosed herein.

With reference now to FIGURE 1 of the Drawings, there is illustrated therein a typical W-CDMA cellular network, generally designated by the reference numeral 100, utilizing the principles of the present invention. The network is divided into a plurality of cells 110 that indicate the typical area of coverage for a base transceiver 120 located in the middle of each cell. Other base transceiver 120 and cell 110 arrangements are possible as would be known to one of skill in the art. Each base transceiver 120 within the cellular network is coupled to one or more central base controllers 130 for communication therewith. Each central station 130 comprises or is coupled to a switching center 140. The switching center is typically coupled to a PSTN network 190. Each central base controller 130 facilitates communication between base transceivers 120 and PSTN network callers. Additionally, the central base controller coordinates the interoperability of the base transceivers 120 concerning certain tasks, such as handing off mobile transceivers 150 from one cell to

another. The central base controller 130 also comprises or has access to a centralized database 180. The database 180 contains information regarding the various users that subscribe to the associated wireless network, such as their classifications. By accessing information contained in the database 180 through the central base controller 130, the base transceivers 120 can identify the classification of the mobile transceiver 150 associated with a new call.

Operationally, voice signals are transmitted between a mobile transceiver 150, such as a cellular phone, and the base transceiver 120 located within an associated cell 110. Prior to transmitting the voice signal over a wireless connection to a transceiver 120 or 150, the signal is typically compressed by a vocoder (voice coder). It can be appreciated that by compressing the size of a voice signal prior to transmission, the total number of signals that may be supported in a limited bandwidth environment can be increased. However, as a voice signal is compressed, its quality degrades. The vocoders in W-CDMA and CDMA2000 permit several different compression levels of voice encoding to allow network operators to offer plans to customers based on a chosen level of encoding. For instance, the vocoder specified with W-

CDMA permits the voice signal to be compressed to eight different levels: 4.75 kbps; 5.15 kbps; 5.9 kbps; 6.70 kbps; 7.40 kbps; 7.95 kbps; 10.2 kbps and 12.2 kbps. Voice signals that are more highly compressed on average exhibit lower levels of perceptual quality than those that are compressed less. However, depending on other noise generating factors that affect two different W-CDMA signals, a more highly compressed signal may exhibit a greater perceptual QoS than a less compressed counterpart at a given point in time within a call.

With reference now to FIGURE 2 of the Drawings, there is graphically illustrated therein a CDMA voice transmission, generally designated by the reference numeral 200. FIGURE 2 illustrates how the received quality level of a CDMA voice transmission may vary over time depending on the various environmental factors affecting the voice signal. Line 210 represents mean opinion score (MOS) quality levels 220 that may be perceived by a user at certain points along a timeline 230 during a CDMA network voice transmission. MOS is the primary measure of voice quality within the wireless telephone industry. Environmental factors such as the location of the user relative to a transceiver can significantly affect call quality. For instance, the

quality may drop as indicated at time 240 when a user is deep within a building since the CDMA signal has difficulty carrying through walls. Additionally, as the number of simultaneous users within a cell 110 increases, the noise level may increase, thereby reducing the perceptual QoS. Conversely, the perceptual QoS may increase to relatively high levels as shown at time 250 when a user is located close to the base transceiver 120 and there are a minimal number of simultaneous users within the cell 110.

With reference now to FIGURE 3 of the Drawings, there is graphically illustrated three separate categories of service, generally designated by the reference numeral 300. FIGURE 3 illustrates how the perceptual quality of the different class subscribers is maintained as close as possible to the appropriate level. According to one embodiment of the present invention, three separate subscription classifications are specified: an executive class 310; a standard class 320; and an economy class 330. As illustrated in FIGURE 3, the perceptual quality 340 of the executive class subscribers is maintained as close as possible to an excellent level. The perceptual quality of the standard class subscribers is maintained as close as possible to a

good level, and the perceptual quality of the economy class subscribers is maintained as close as possible to a fair level. In variations of the illustrated embodiment, the network provider may provide the standard and economy subscribers with signal quality above their subscribed classification if the excess bandwidth is available, lowering quality of the voice signal to the subscribed level as the number of active users within a cell increases and excess capacity is no longer available. In another variation, the economy class user may not be guaranteed a certain quality level; rather, the perceptual QoS levels provided to the economy subscribers may be reduced as necessary to ensure that the perceptual QoS levels of the executive and standard class users are maintained. As would be obvious to one with skill in the art, any number of different subscriber plans may be offered, wherein the protocols utilized to determine and maintain a user's perceptual quality of service are varied accordingly.

With reference now to FIGURE 4 and related FIGURE 5 of the Drawings, there is illustrated in FIGURE 4 a block diagram, generally designated by the reference numeral 400, illustrating a system for (1) measuring perceptual QoS metrics that correlate to a user's perceptual QoS and

(2) making adjustments to the transmission protocols to adaptively change the perceptual QoS of the voice signal in real time according to the user's subscribed level of service on the downlink transmission. Related FIGURE 5 illustrates, by way of a flow diagram, generally designated by reference numeral 500, a method for adaptively adjusting the transmission protocols of a network device based on metrics that correlate with the user's perceptual QoS.

Referring to block 505 of FIGURE 5, communication channels are established between a base transceiver 120 and a mobile transceiver 150. As is described in greater detail below, the base transceiver 120 must determine whether to accept or block a new call, or whether to accept a handoff or drop a call that is moving into its cell 110 from another. The determination whether to accept, drop or block a call can depend on the classification of a particular mobile transceiver 150. Provided the call is accepted, at least two channels 410 and 420 are established. One channel serves to transmit a voice signal from the base transceiver 120 to the mobile transceiver 150 and is referred to herein as the downlink channel 410. The other channel serves to transmit a voice signal and perceptual QoS data to the

base transceiver 120 from the mobile transceiver 150. A minimum of two channels is required for full duplex communication, although in alternative embodiments, communication between the transceivers can be established over additional channels. For instance, a third or forth channel can be established solely for the purpose of transmitting channel control data between the transceivers, wherein the uplink and downlink channels 410 and 420 are used only to transmit voice signals.

As indicated by block 510, the base transceiver 120 transmits a compressed voice signal to the mobile transceiver 120. It should be appreciated that the voice signal may originate from a PSTN signal sent to the base transceiver 120 through a switching station 140, which is ultimately in communication with a device such as a telephone connected to the PSTN network, or the call may originate from another mobile transceiver 150 in communication with the base transceiver 120 through other channels. The signal is received by the mobile transceiver 150 as indicated in block 515.

After the voice signal is received, it is decompressed by a vocoder 430 in the mobile transceiver 150 as indicated by block 520. The vocoder 430 is preferably resident in software that utilizes a processor

or processing unit 490 contained within the mobile transceiver 150, although in alternative embodiments the vocoder 430 can be resident in dedicated hardware. The decompressed signal is then transmitted to a speaker 440 for audio transmission to the user of the mobile transceiver 150 as shown in block 525.

Referring to block 530, concurrently or in close proximity with the transmission of audio to the user, the decompressed voice signal is analyzed by a voice signal perceptual QoS analyzer 450 to determine perceptual QoS metric values that are related to humanly perceptible anomalies in the voice signal. Software to measure telephone voice quality is commercially available, such as Multi-VQ and Dual-VQ that are sold by Genista Corp. of Japan, the assignee of the present invention.

Most wireless communications networks provide mechanisms for selecting the transmission parameters between two or more connected devices to improve the quality of service for a call. The metrics used in determining whether to make changes to the connection do not necessarily relate directly to the perceptual quality of a transmission as experienced by a user of the network. For instance, in a CDMA wireless network, the base station will, based on information received from the

wireless telephone regarding frame-error rates (FER), modulate the power level of its transmission to the receiver. Unfortunately, FER information does not directly relate to the telephone user's perceptual quality of the transmission. For instance, a high FER may not degrade the perceptual quality of a transmission if the frames are dropped in isolation relative to each other. Conversely, a transmission with a low overall FER may cause a perceptual variation in the voice transmission if frames are dropped or lost consecutively or in close proximity to each other.

The primary measure of voice quality used within the wireless telephone industry is the Mean Opinion Score (MOS). A MOS is the result of subjective listening tests, wherein human subjects compare various audio samples generated from voice signals and assign a quality value of 1 to 5. The MOS is an arithmetic mean determined for a particular voice signal from a large sample. Typically, MOS's have been used to characterize the relative quality of vocoder compressed voice signals, although MOS's can also be used to determine the perceptual transmission quality for wireless voice signals, subject to a variety of conditions. As a point of reference, land lines transmitting at 16 kbps typically have MOS's of around

3.6-3.7; whereas, voice signals compressed to 4.75 kbps for wireless transmission have MOS's around 3.2. Since the traditional method of generating a MOS requires a large sample of people listening to and rating a transmission, it is obviously not practical to make real time measurements of voice quality using this methodology. MOS's are, therefore, typically limited to use in developing best practices scenarios for voice signals transmitted under certain predetermined conditions.

As discussed above, Dual-VQ is a voice quality tool that is run on a windows platform to analyze voice files for various numerical or digital characterizations of audio anomalies that a user can perceive. In particular, Dual-VQ detects and measures voice choppiness, delay variation (jitter), and variations in active speech levels. Dual-VQ provides a variety of metrics describing the quality of the analyzed voice signal, including a MOS metric. The MOS metric generated by Dual-VQ has been found to exhibit a 97% correlation with MOS's derived by traditional methods. It is within the ordinary level of skill of someone in the software and programming arts to port a version of the voice perceptual QoS tools for operability within a cell phone for use by a microprocessor contained within the cell phone. By using

this type of software tool resident in the mobile transceiver 150, voice signals can be analyzed and perceptual QoS metrics generated in real time that directly correlate to humanly perceptible variations in the quality of a voice signal. In the simplest form, the resulting metric may be a single number indicating the overall quality of the voice signal similar to a MOS, or a more sophisticated set of data may be obtained that individually describes the various anomalies within the voice signal.

Returning now to block 535, the resulting data concerning perceptual QoS is transmitted over the uplink channel 420 to the base transceiver 120. The base transceiver 120 then uses the data to adjust channel and network parameters based on the data as shown in block 540. In an alternative embodiment, the perceptual QoS data may be transmitted to the base transceiver 120 over a dedicated data link instead of over the uplink channel 420 with the voice signals.

The perceptual QoS data is utilized to adjust the quality of the voice signal either upwardly or downwardly to match a particular perceptual QoS level associated with a user of a particular mobile transceiver 150. For example, a business person may desire the best possible

perceptual QoS level with regard to his mobile phone, and may be willing to pay a premium for a guarantee that he will have the best possible signal. In this instance, the base transceiver 120 will adjust the transmission characteristics to maximize the perceptual QoS. On the other hand, a college student may be willing to live with a lower perceptual QoS in return for an inexpensive rate plan. In this instance, the base transceiver may adjust the college student's perceptual QoS downwardly, when it exceeds the student's subscribed level.

With reference now to FIGURE 6 of the Drawings, there is illustrated therein a graph, generally designated by the reference numeral 600, that illustrates how a signal might be adjusted during a phone call to match the perceptual QoS characteristics of the voice signal as closely as possible with the user's subscribed perceptual QoS level. Line 610 indicates the relative quality level of the signal in terms of a perceptual QoS metric as it would be experienced without the use of a perceptual QoS adaptive system. Line 620 indicates the perceptual QoS level after the adjustment of applicable transmission parameters, such as, but not limited to the power level of the voice signal transmission, the soft capacity of the cell, the soft coverage of the cell, and

the compression level of the voice signal. For example, at time 630 when the perceptual QoS level is higher than the user's contracted level (assuming the user contracted for a "fair" perceptual QoS level), the vocoder for downlink transmission may be directed by the base transceiver's processing unit 490 to increase the level of compression of the voice signal to lower the user's perceptual QoS; thereby, freeing up capacity within the cell for use by other users. At time 640, however, when the unadjusted perceptual QoS level is significantly below the contracted level, the processing unit 490 within base transceiver 120 may initiate parameter adjustments to increase the user's perceptual QoS, such as directing the power controller 460 to boost the power of the signal transmitted to the user, and/or decreasing the amount of vocoder compression. At time 650, the entire cell 110 may be experiencing greater than acceptable levels of noise as compared to neighboring cells, in which case the base transceiver's processing unit may direct a soft capacity controller 480 and the soft coverage controller 470 to decrease the geographic coverage and capacity of the cell to improve the perceptual QoS of all the active mobile transceivers 150 located within the cell 110.

With reference now to FIGURE 7 of the Drawings, there is illustrated therein a graph, generally designated by the reference numeral 700, that illustrates how the voice signal rate 730 of a particular voice signal (as defined by the compression level) generated by the downlink vocoder may vary as a function of time 720. The vocoder utilized in a W-CDMA is capable of compressing a voice signal into one of a plurality of rates from 4.75 kbps to 12.2 kbps. Depending on the perceptual QoS metrics provided by a mobile transceiver 150, the base transceiver 120 can dynamically adjust the compression rate accordingly. Line 710 shows the voice signal rate at various points during a 20 second time span of a telephone call. CDMA 2000, another third generation CDMA network also utilizes a vocoder that's capable of adjusting compression levels of a voice signal before transmission of the voice signal.

As indicated in FIGURE 5, the perceptual QoS of a voice transmission is continuously monitored in real time to detect variations in the quality of the signal and make the proper adjustments before any change in the perceptual QoS becomes noticeable to a user. As can be appreciated by someone with skill in the art, the sampling rate of the voice signals can be varied as can

the duration of the sampled portions. Although sampling short duration portions of the voice signal is within the capability of current electronic arts, it is preferred in embodiments of the present invention that analyzed portions of the voice signal be of sufficient duration, typically a half second or greater, so that perceptual QoS anomalies that are perceptual to a human can be identified.

As illustrated above, perceptual QoS metrics can be utilized to both (i) make a determination whether to adjust the perceptual QoS of a single mobile transceiver within a cell and (ii) to make a determination whether to adjust the transmission characteristics of the cell as a whole. Furthermore, the perceptual QoS metrics can be utilized by a central base controller 130 to adjust the relative perceptual QoS levels in one cell 110 compared to another neighboring cell 110. For example, if most of the users in a first cell are experiencing perceptual QoS levels in excess of their contracted levels and the users in a neighboring second cell are simultaneously experiencing levels below their contracted levels, the central base controller 130 can direct the poorly performing first cell to contract and reduce its capacity while directing the second cell to expand its coverage

and capacity to include those users that will be placed outside of the first cell's new coverage area. Accordingly, as the perceptual QoS levels in the first cell increase and the perceptual QoS levels of the users in the second cell decreases, the perceptual QoS levels of users in both cells can be harmonized.

The present invention has been described above concerning an embodiment wherein a cellular base transceiver 120 adjusts its transmission parameters based on humanly perceptual QoS metrics received from a mobile transceiver 150 regarding voice signals sent from the base transceiver. Embodiments of the invention may, however, be applied in reverse, wherein the mobile transceiver 150 adjusts it voice signal transmission parameters based on perceptual QoS metrics received from the base transceiver 120.

As discussed, in certain embodiments of the present invention, subscriber classifications may also be used by a cell to determine whether to accept or reject a call including those calls associated with a mobile transceiver moving into the cell or whether to drop an active call within a cell. According to one embodiment, this functionality is provided by a dynamic capacity manager 495 (DCM) resident in the base transceiver 120 as

illustrated in FIGURE 4. It should be appreciated that the DCM 495 may also be resident in the central base controller 130 or in the switching center 140. Further, one of ordinary skill in the art would also appreciate that the DCM 495 may be resident in software that is executable using the base transceiver's processing unit 490 or the DCM 495 may be resident in hardware. The DCM 495 can utilize any number of algorithms to decide whether to accept or reject a new call moving into or being initiated within a cell as would be obvious to one of ordinary skill in the art with the benefit of this disclosure.

With reference now to FIGURE 8 of the Drawings, there is illustrated therein a graph, generally designated by the reference numeral 800, that illustrates how the DCM 495 allocates the capacity of its associated cell among three subscriber classifications. The executive, standard and economy allocated portions 810, 820 and 830 of the cell's capacity 840 vary with time 850 depending on the number of active users from each class within the cell at any one time. Depending on the criteria used by the network provider, certain minimum portions of the total capacity may be reserved for users of certain classifications, such as the executive class,

regardless of the demand for capacity from the other classifications and regardless whether the capacity is being actively used. It is also anticipated that adjustments to the relative allocations can be based upon historic data indicating expected usage patterns of the various classifications depending on the time and the day of the week. Additional allocations can also be made based on additional user classifications and/or the different types of data that can be transferred over the wireless network. For instance, a certain amount of a cell's capacity can be allocated to handle data related to email and wireless web browsing.

Because the capacity requirements with each wireless telephone call can vary during the length of the call based on changes to the amount of compression applied to the voice signal by the vocoder, it is not possible to predict with great precision, the total capacity required for all the simultaneous users within a particular class. Although the base transceiver could reserve sufficient capacity for all active users within a classification based on the maximum voice signal rate (12.2 kbps for W-CDMA) for each active user, this would result in a potentially significant amount of unused but reserved capacity, thereby lessening the efficiency of the cell.

Furthermore, such a methodology would be contrary to the goal of maximizing the utility of the wireless network (i. e. maximizing the revenue generating potential and/or the number of users of varying classifications that can be supported at a time). To maximize the utilization of the network, the allocation for each classification can be based on the average voice signal rate generally necessary to maintain the subscribed perceptual QoS of the class multiplied by the number of active users at any given time. Unfortunately, this approach does not allocate any additional capacity for (i) new callers or (ii) increases in the voice signal rates of the active users above the average rate as necessary to maintain necessary quality levels.

Ideally, when a cell 110 is operating near capacity, a small amount of capacity will be reserved within each class allocation, to accommodate for variations in the capacity necessary to support the active users within the classification, as well as, support the addition of new users. The minimum amount of capacity reserved within each classification can vary. For example, a greater minimum amount of reserve capacity relative to the number of active users therein may be provided for the executive allocation, than for the standard allocation. The

economy allocation may have an even smaller minimum reserve.

The determination of the size of any minimum reserve can be based on any number of criteria. In one embodiment, the minimum total capacity (the capacity being utilized plus any reserve capacity) necessary to support a certain number of active users within a class allocation is based on the probabilities that a call within the class will be dropped and the probability that a new call within the class will have to be blocked rather than accepted. The probability that a call will be either blocked or dropped under a given set of conditions within a cell can be determined from a statistical regression analysis of the past operation of the cell 110. The table below indicates the minimum probabilities that must be maintained within each of the executive, standard and economy allocations according to one embodiment of the invention.

CLASS	P_{BLOCK}	P_{DROP}
EXECUTIVE	1%	0.5%
STANDARD	3%	2%
ECONOMY	5%	3%

As indicated, enough total capacity for a given number of active users within the executive class must be maintained so that the probability that a new call is blocked is 1% or less, and the probability that an active call is dropped is less than 0.5%. In the case of the standard allocation, the probability that a new caller may be blocked can be as high as 3%, and the probability that an active caller is dropped is less than 2%. In the case of the economy allocation, the probability that a new caller may be blocked can be as high as 5%, and the probability that an active caller is dropped can be as high as 3%.

As described above, in alternative embodiments, a minimum reserve capacity may not be provided for the economy allocated portion. Likewise, no maximum probability of blocking or dropping is maintained. It is to be appreciated that in this variation, the actual probabilities that an economy user will get his/her call dropped or blocked can be very high when the cell is operating near or at its capacity.

As stated above, the total capacity allocated to any classification will vary with the number of users that are active from each classification. Ultimately, the total amount of capacity allocated among the various

classifications cannot exceed the total available capacity of the cell. Accordingly, an algorithm is utilized defining rules that are applied when determining whether to accept a call from one classification over another and reallocating the allocated portions for each of the classifications. It can be appreciated that callers from classifications that pay more for their service are likely to be given a higher priority than callers from classifications that provide a less expensive service. In the preferred embodiment, as described above, executive, standard, and economy classifications are provided based on plans differentiating perceptual QoS levels provided for users within each classification.

Exemplary algorithms that can be utilized by a DCM 495 to determine whether to admit a new call 110 within a cell based on the caller's classification are illustrated in the flow charts of Figures 9-11. Initially, upon receipt of a request to initiate a new call within a cell 110, the associated base transceiver 140 must determine the classification of a new call whether the call is being transferred from a neighboring cell 120 or the call is being initiated within the cell. Information identifying the classification of the mobile transceiver

150 from which the call is originating or to which the call is to be placed is contained within the centralized database 180 that is either resident in the central base controller 130 or is accessible by the central base controller. Typically, when a request for the cell to handle a new call that is either being transferred into the cell or is being initiated by another to a mobile transceiver 150, the information regarding the targeted mobile transceiver's classification is sent with the request for service. When the call is being initiated within the cell, the base transceiver 120 queries the central base controller 130 for information concerning the mobile transceiver's classification.

With reference now to FIGURE 9 of the Drawings, there is illustrated a block diagram, generally designated by the reference numeral 900, illustrating the steps of the algorithm for admitting an executive level call request. The admission process begins at block 910 where a new call is identified as being associated with a mobile transceiver of an executive class user. Next, the DCM 495 determines whether there is enough capacity to support the call within the executive allocated portion of the cell's total capacity in block 915. If the

capacity is available in the allocated portion, the call is admitted as shown in block 920.

If the capacity is not available in the executive allocated portion, the DCM 495 next determines whether there is excess capacity that could be transferred to the executive allocated portion from the economy or standard allocated portions as indicated in block 925. If capacity is available, it is reallocated to the executive allocated portion in block 930 and the call is admitted in block 935.

If capacity is not available in either of the other classifications in block 940, the DCM 495 determines whether it can change the parameters of any of the active callers to free additional capacity. For instance, if the economy users service contract does not specify a minimum perceptual QoS level, the DCM 495 may lower the voice signal rate of one or more of the active economy users to free capacity for the executive allocated portion as shown in block 945, and admit the call into the reallocated executive allocated portion in block 950.

If the parameters of the active callers cannot be changed to free up capacity for a new caller while maintaining the contractual perceptual QoS levels of the active callers, the DCM 495 may in concert with the

central base controller 130 and a neighboring cell 110 determine whether the new call may be transferred to the neighboring cell as indicated in block 955, wherein the parameters of the cells are modified as necessary in block 960 and the call is admitted into the neighboring cell in block 965. Alternatively, the central base controller 130 may determine whether the new call can be serviced by modifying the soft capacity and soft coverage areas of the various cells 110 that it controls. For instance, if the new call is initiated in a first cell that is operating at or near full capacity, and the neighboring cells 110 are operating at some fraction of their capacity, the central base controller 130 may direct the first cell to contract and transfer some of its active callers to the neighboring cells, which are directed to expand to handle the displaced callers. Accordingly, capacity is created in the first cell to service the new call. It is understood that any modifications made to the cells 110 by the central base controller 130 must be done in such a manner as to maintain the contracted perceptual QoS levels of the active users within the network. If it is not possible to modify the cell or the neighboring cells to generate additional capacity, the call is blocked in block 970.

In general, a similar algorithm is utilized by DCM 495 in determining whether to admit a call associated with a standard user as is utilized for the executive user. As a general rule, however, when a conflict arises wherein both an executive class call and a standard class call are requesting the same unused capacity, the executive class call will be given priority over the standard class call.

With reference now to FIGURE 10 of the Drawings, there is illustrated a block diagram, generally designated by the reference numeral 1000, illustrating the steps of the algorithm for admitting a standard level call request. The admission process begins at block 1010 where a new call is identified as being associated with a mobile transceiver 150 of a standard class user. Next, the DCM 495 determines whether there is enough capacity to support the call within the standard allocated portion of the cell's total capacity in block 1015. If the capacity is available in the allocated portion, the call is admitted as shown in block 1020.

If the capacity is not available in the standard allocated portion, the DCM 495 determines whether there is excess capacity that could be transferred to the standard allocated portion from the economy allocated

portion or any excess reserve in the executive allocated portion as indicated in block 1025. If capacity is available, it is reallocated to the standard class allocated portion in block 1030 and the call is admitted in block 1035.

If capacity is not available in either of the other classifications, the DCM 495 determines whether it can change the parameters of any of the active callers to free additional capacity in block 1040. For instance, if the economy users service contract does not specify a minimum perceptual QoS level, the DCM 495 may lower the voice signal rate to one or more of the active economy users to free capacity for the standard allocated portion as shown in block 1045, and admit the call into the reallocated standard allocated portion in block 1050. If additional capacity cannot be freed, the call is blocked in block 1055.

Since the economy classification is generally associated with low cost service plans, the call management algorithm associated with the economy classification may not provide the DCM 495 with as many options in placing a call. In general, placement of an economy class call is likely to be a capacity available

basis only with executive and standard class calls taking precedence.

With reference now to FIGURE 11 of the Drawings, there is illustrated a block diagram, generally designated by the reference numeral 1100, illustrating the steps of the algorithm for admitting an economy level call request. The admission process begins at block 1110 where a new call is identified as being associated with a mobile transceiver of an economy class user. Next, the DCM 495 determines whether there is enough capacity to support the call within the economy allocated portion of the cell's total capacity in block 1115. If the capacity is available in the allocated portion, the call is admitted as shown in block 1120. If the capacity is not available in the economy allocated portion, the DCM 495 determines whether there is excess capacity that could be transferred to the economy allocated portion from any excess reserve in the standard or executive allocated portions as indicated in block 1125. If capacity is available, it is reallocated to the economy class in block 1130 and the call is admitted in block 1135. If additional capacity cannot be freed, the call is blocked in block 1140.

The algorithms described above are merely exemplary. Other algorithms can be utilized as would be obvious to one of ordinary skill in the art with the benefit of this disclosure. For instance, one embodiment may specify that excess reserve capacity associated with one or more classifications be utilized on an available basis to transfer email and other data over the wireless network that may not be as time dependent as real time voice communications. In other embodiments, the sizes of the various allocated portions of a cell's capacity may be fixed or variable only according to preset time based allocation schemes. Additional operations could be specified to ensure a call, especially one associated with a high level classification, is accepted. For instance, economy callers may be dropped as necessary to free capacity for executive class users.

Additionally, the DCM 495 may utilize "soft handoffs" with certain classifications and "hard handoffs" with others. A "soft handoff" occurs when prior to being transferred from one cell 110 to another cell 110, the mobile transceiver 150 is in communication simultaneously with base transceivers in both cells. In other words, the current cell does not end communications with the new cell until after the new cell has begun

communications with the mobile transceiver 150. This process is distinguishable from a traditional "hard handoff", wherein communication with the one cell is terminated at the same time communication is established with a new cell. If the new cell does not have enough available capacity or cannot free additional capacity in a very short period of time, the call subject to a "hard handoff" is dropped.

Since communication of a voice signal to a mobile transceiver 150 is handled by at least two cells 110 during the soft handoff, the base transceiver 120 in the new cell can pre-allocate capacity to a call associated with the mobile transceiver before all of the capacity is needed. The amount of capacity allocated for the call may be the entire amount necessary if the mobile transceiver 150 moves completely into the new cell or it may be a fraction thereof. For example, a cell 110 may be servicing ten mobile transceivers in a "soft handoff" situation at a point in time, and based on statistical model, only seven of those mobile transceivers will actually transfer into the new cell completely. Accordingly, the base transceiver of the new cell may only allocate 70% of the necessary capacity for each mobile transceivers associated with the "soft handoff"

since only 7 of the 10 mobile transceivers are likely to move completely into the new cell.

Because "soft handoffs" can increase the capacity demands on a particular base station, especially if capacity is pre-allocated as described above, "soft handoffs" may not be made available to all service plan classifications. For instance, in one embodiment "soft handoffs" may be utilized for the executive class users in all instances, and for standard class subscribers in situations when the cells 110 within the network are not operating near capacity. Certain embodiments may not permit "soft handoffs" for economy class users. It is to be appreciated that the amount of capacity pre-allocated to mobile transceivers 150 associated with different classes may vary as well, wherein more capacity will be pre-allocated to the executive class than the standard class.

Exemplary embodiments of the invention are described herein primarily in terms of a W-CDMA-based wireless network. It is to be appreciated that certain aspects of this invention are applicable to other types of wireless communications networks including CDMA1 and CDMA2000 networks as well as those technologies based on the TDMA mode of communication, as would be obvious to one of

ordinary skill in the art with the benefit of this disclosure. Furthermore the present invention has been described in relation with voice communications. It would be obvious to one of ordinary skill in the art with the benefit of this disclosure that the principles disclosed herein are equally applicable to the transmission of other perceptually effected transmissions such as streaming audio and streaming video.

The foregoing description of the present invention provides illustration and description, but is not intended to be exhaustive or to limit the invention to the precise one disclosed. Modifications and variations are possible consistent with the above teachings or may be acquired from practice of the invention. Thus, it is noted that the scope of the invention is defined by the claims and their equivalents.

The present application claims priority from U. S. provisional patent application Serial No. 60/245,111, entitled "System and Method for Quality Billing," filed on November 1, 2001, which is incorporated herein by reference as if fully set forth.

(Industrial Applicability)

This invention is applied generally to wireless communications over a cellular network, and more particularly to linking the billing of network services to the perceptual quality of service (QoS), and enhanced call admission protocols based upon a plurality of available perceptual QoS levels.

CLAIMS

1. A method of operating a communications network, said communications network comprised of a plurality of cells, said method comprising the steps of:

assigning a first category of service from a plurality of categories of service to a communications device, said categories of service comprised of varying levels of network resources, said levels of network resources generating varying levels of perceptual quality of service (QoS) of signals;

establishing a communications session between said communications device and a base station transceiver; and

billing a user of said communications device for use of said network based upon said first category of service.

2. The method according to claim 1, wherein said communications network is selected from the group consisting of: a code division multiple access network (CDMA) and a time division multiple access network (TDMA).

3. The method according to claim 1, wherein the perceptual QoS is based upon one or more humanly

perceptible anomalies selected from the group consisting of: voice distortion, voice choppiness, voice jitter, variations in voice level, audio distortion, audio choppiness, audio jitter, variations in audio level, video distortion, video choppiness and video jitter.

4. The method according to claim 1, wherein said user is charged more for using categories of service generating higher perceptual QoS.

5. The method according to claim 1, further comprising the step of:

adjusting network parameters to allocate appropriate network resources to maintain the perceptual QoS associated with said first category of service for said communications device.

6. The method according to claim 5, wherein said network parameters are adjusted to reduce the occurrence of one or more humanly perceptible anomalies in the quality of said signal.

7. The method according to claim 5, wherein said network parameters are adjusted to increase the

occurrence of one or more humanly perceptual anomalies in the quality of said signal.

8. The method according to claim 5, wherein said network parameters include the level of compression of said signals.

9. The method according to claim 8, wherein said step of adjusting network parameters further comprises the step of:

decreasing the level of compression to reduce the occurrence of one or more humanly perceptual anomalies in the quality of said signals.

10. The method according to claim 8, wherein said step of adjusting network parameters further comprises the step of:

increasing the level of compression to increase the occurrence of one or more humanly perceptual anomalies in the quality of said signals.

11. The method according to claim 5, wherein said step of adjusting network parameters further comprises the step of:

increasing the geographic area of the cell servicing said communications device.

12. The method according to claim 5, wherein said step of adjusting network parameters further comprises the step of:

decreasing the geographic area of the cell servicing said communications device.

13. The method according to claim 5, wherein said step of adjusting network parameters further comprises the step of:

dynamically adjusting the power level of said signals.

14. The method according to claim 5, wherein said step of adjusting network parameters further comprises the step of:

dynamically allocating network resources within a cell from said first category of service to another said category of service based upon capacity requirements of said plurality of categories of service and requests for network resources by users of said communications network.

15. The method according to claim 5, further comprising the step of:

adjusting network parameters for an entire cell in said communications network to allocate appropriate network resources to maintain the perceptual QoS associated with said first category of service.

16. The method according to claim 5, further comprising the step of:

adjusting network parameters for a single communications device in said communications network to maintain the perceptual QoS associated with said communications device.

17. The method according to claim 5, further comprising the step of:

dynamically adjusting the network resources of said plurality of categories of service within a cell, thereby maximizing the efficiency of said communications network.

18. The method according to claim 5, further comprising the step of:

allocating a portion of said network resources within each of said categories of service within a cell to accommodate new call requests.

19. The method according to claim 5, further comprising the step of:

dynamically adjusting the network resources of said plurality of cells to increase the efficiency of said communications network.

20. The method according to claim 5, further comprising the step of:

transferring said communications session from one cell to another cell of said plurality of cells based upon network demands from said varying categories of service.

21. A method of operating a communications network, said communications network comprised of a plurality of cells, said method comprising the steps of:

assigning a first category of service from a plurality of categories of service to a communications device, said categories of service comprised of varying levels of network resources, said levels of network

resources generating varying levels of perceptual quality of service (QoS) of signals;

receiving a request to establish a communications session between said communications device and a base station transceiver; and

determining whether to admit the request based on said category of service and capacity of corresponding network resources for said level of service.

22. The method according to claim 21, wherein said communications network is selected from the group consisting of: a code division multiple access based network (CDMA) and a time division multiple access based system.

23. The method according to claim 21, wherein the perceptual QoS is based upon one or more humanly perceptible anomalies selected from the group consisting of: voice distortion, voice choppiness, voice jitter, variations in voice level, audio distortion, audio choppiness, audio jitter, variations in audio level, video distortion, video choppiness and video jitter.

24. The method according to claim 21, wherein requests to establish a communications session received from a user of a high category of service are given priority over requests to establish a communications session received from a user of a lower category of service.

25. In a communications network having a plurality of cells, a system for billing users of said network, said system comprising:

a plurality of categories of service, each of said categories of service corresponding to respective levels of perceptual QoS of said signals;

a plurality of communications devices, said communications devices subscribing to at least one of said plurality of categories of service;

transmitting means for transmitting signals to said plurality of communications devices;

receiving means for receiving signals from said plurality of communications devices; and

billing means for billing users of said communications network based on the respective category of service employed by the respective user in said communications network.

26. The system according to claim 25, wherein said communications network is selected from the group consisting of: a code division multiple access based network (CDMA) and a time division multiple access (TDMA) based network.

27. The system according to claim 25, wherein the perceptual QoS is based upon one or more humanly perceptible anomalies selected from the group consisting of: voice distortion, voice choppiness, voice jitter, variations in voice level, audio distortion, audio choppiness, audio jitter, variations in audio level, video distortion, video choppiness and video jitter.

28. The system according to claim 25, wherein said user is charged more for using categories of service generating higher perceptual QoS.

29. In a communications network having a plurality of cells, a system for admitting call requests into said network, said system comprising:

a plurality of categories of service, each of said categories of service corresponding to respective levels of perceptual QoS of signals;

a plurality of communications devices, said communications devices subscribing to one of said plurality of categories of service;

a receiving means for receiving respective call requests from said plurality of communications devices;

a processing means for determining whether to admit said call request into said communications network based upon the respective category of service employed by respective users and the current network capacity of said communications network.

30. The system according to claim 29, wherein said communications network is selected from the group consisting of: a code division multiple access based network (CDMA) and a time division multiple access (TDMA) based network.

31. The system according to claim 29, wherein the perceptual QoS is based upon one or more humanly perceptible anomalies selected from the group consisting of: voice distortion, voice choppiness, voice jitter,

variations in voice level, audio distortion, audio choppiness, audio jitter, variations in audio level, video distortion, video choppiness and video jitter.

32. The system according to claim 29, wherein requests to establish a communications session received from a user of a high category of service are given priority over requests to establish a communications session received from a user of a lower level of service.

33. The system according to claim 29, wherein said processing means dynamically adjusts the network resources of said categories of service to increase the efficiency of said communications network based upon the number of said call admission requests and the current network capacity within said categories of service.

34. The system according to claim 29, wherein said processing means rejects a call request if sufficient network resources do not exist within said communications network to connect said call request.

35. A communications network comprising:

a plurality of mobile transceivers, said mobile transceivers configured to transmit and receive signals;

a plurality of base transceivers, said base transceivers configured to adjust the perceptual QoS of said signals;

a plurality of categories of service, said categories of service based upon respective levels of perceptual QoS of said signals; and

a billing means, said billing means being based upon the respective category of service employed by respective users in said communications network.

36. The communications network according to claim 35, wherein said communications network further comprises:

admitting means, wherein said admitting means receives a call request from a user to place a call on said communications network and determines, based upon the respective category of service employed by said user and the current network capacity, whether to admit said call request.

37. The communications network according to claim 36, wherein said admitting means denies admission of said

call request if admission of said call would drop said perceptual QoS level below a predetermined level for the respective category of service employed by said user and other users of the network.

38. The communications network according to claim 35, further comprising:

a signal modifying means, wherein said signal modifying means dynamically modifies network parameters within said communications network to maintain the perceptual QoS of said signal within the range defined by the respective category of service for a user.

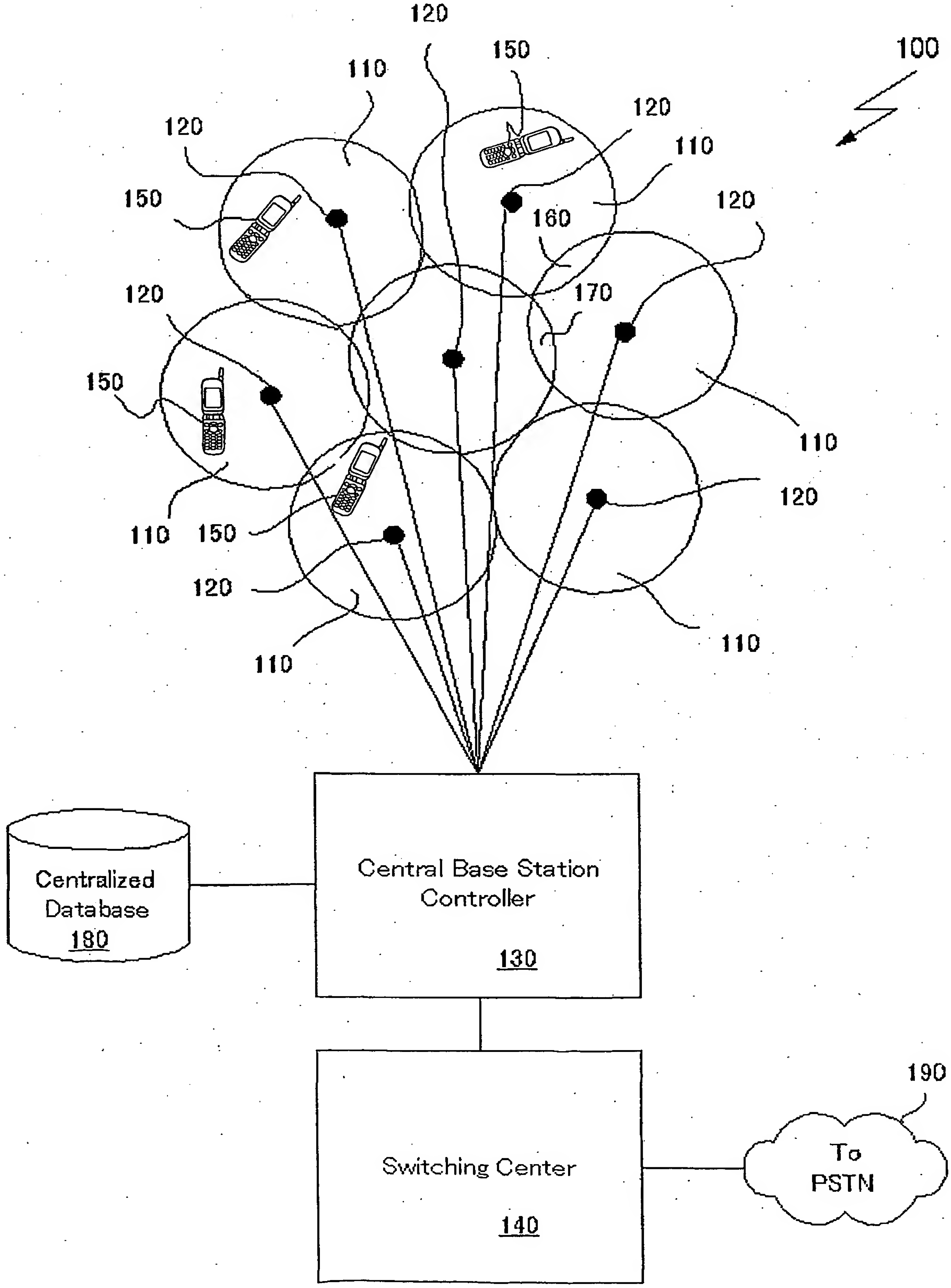
39. The communications network according to claim 38, wherein said signal modifying means dynamically modifies said network parameters to maintain said perceptual QoS for said plurality of categories of service.

40. The communications network according to claim 39, wherein said network parameters include the geographic size of at least one cell within said communications network.

41. The communications network according to claim 39, wherein said network parameters include allocations of network resources of said communications network to respective categories of service within at least one cell within said communications network.

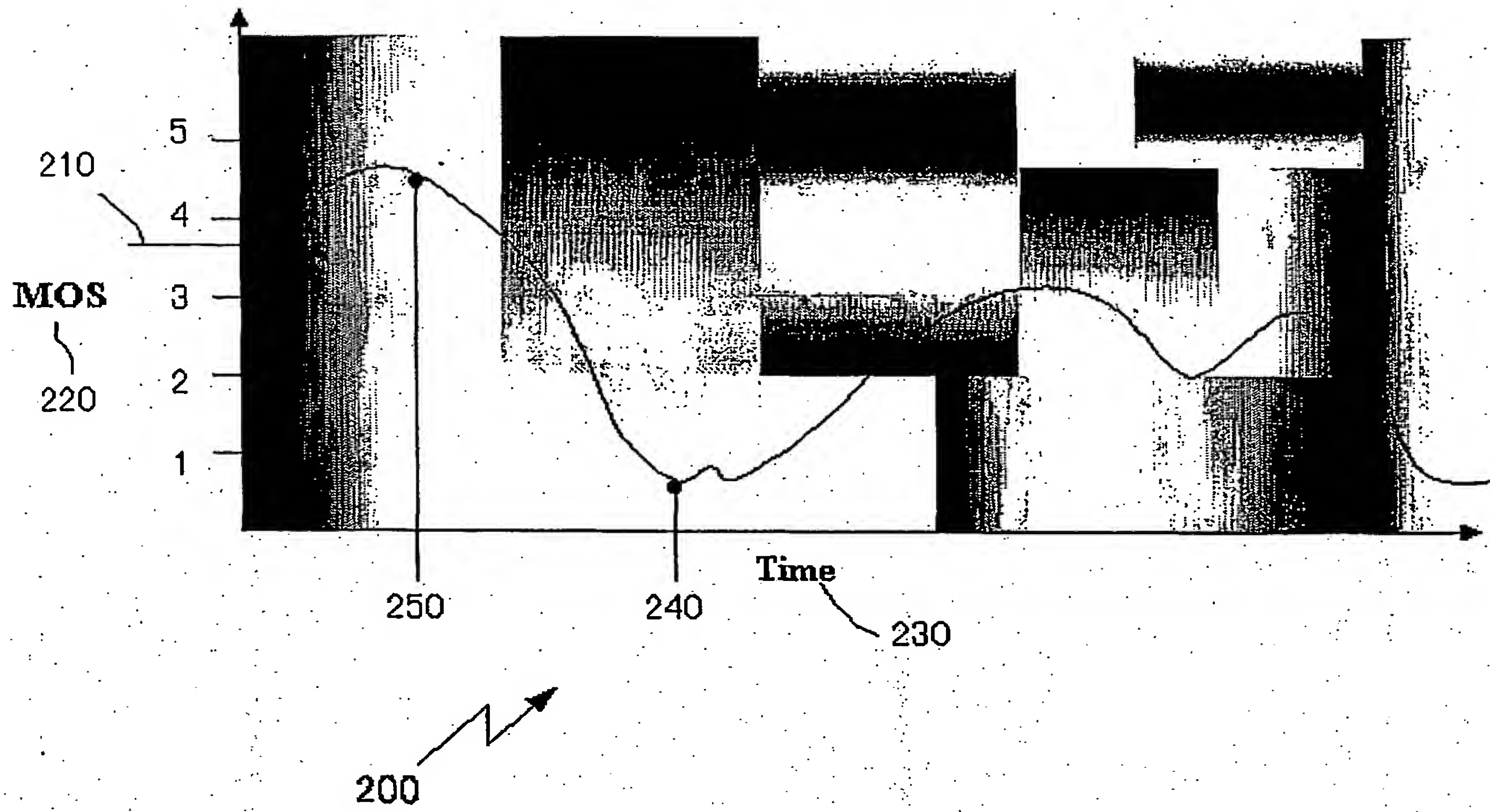
42. The communications network according to claim 39, wherein said network parameters comprise respective compression levels of said signals.

FIG.1



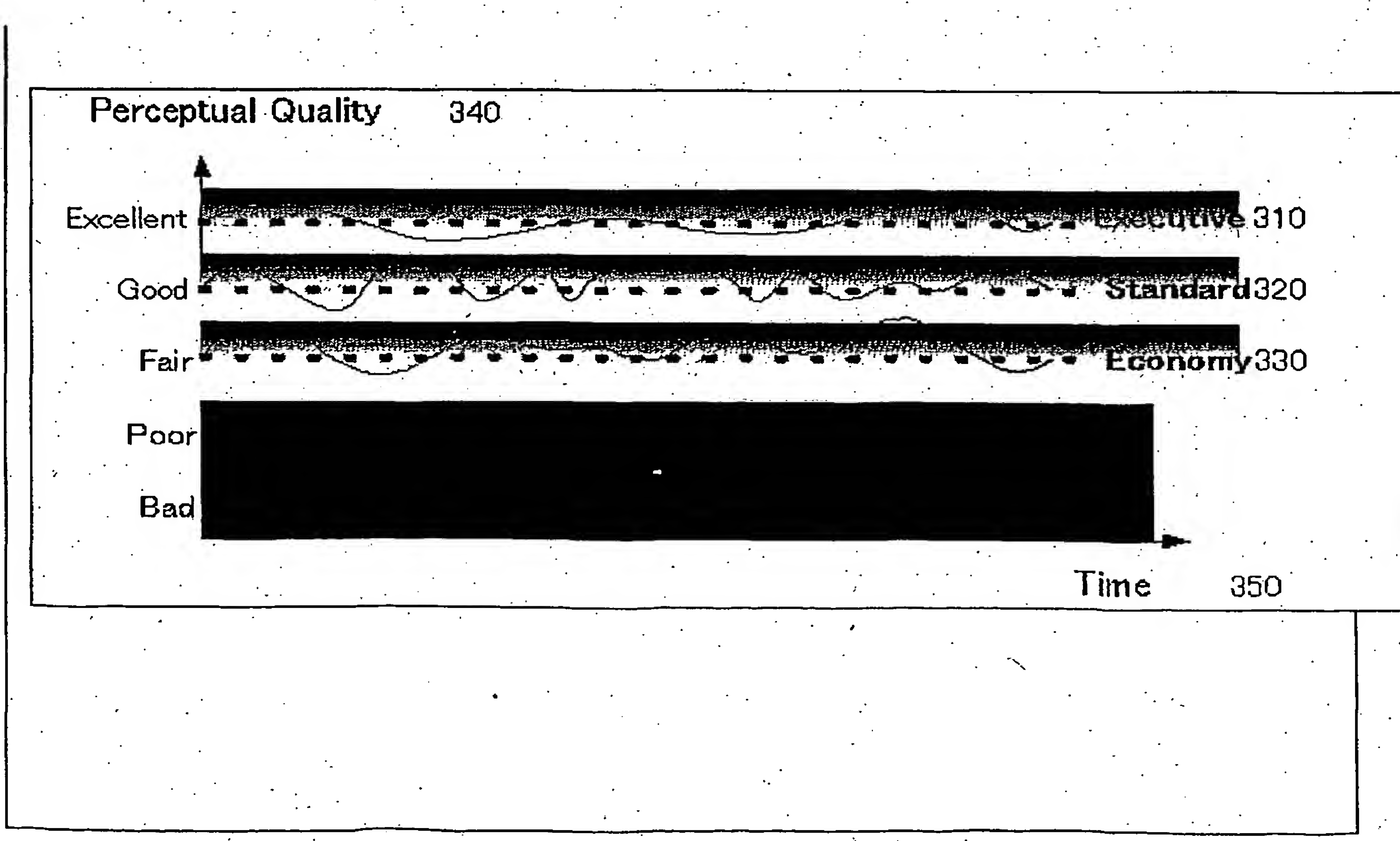
100
110
120
150
160
170
Centralized Database
180
Central Base Station Controller
130
Switching Center
140
To PSTN
190

FIG.2



5
4
3
2
1
210
MOS
220
250
240
Time
230
200

FIG.3



Perceptual Quality 340
Excellent
Good
Fair
Poor
Bad
Executive 310
Standard 320
Economy 330
Time 350

FIG.4

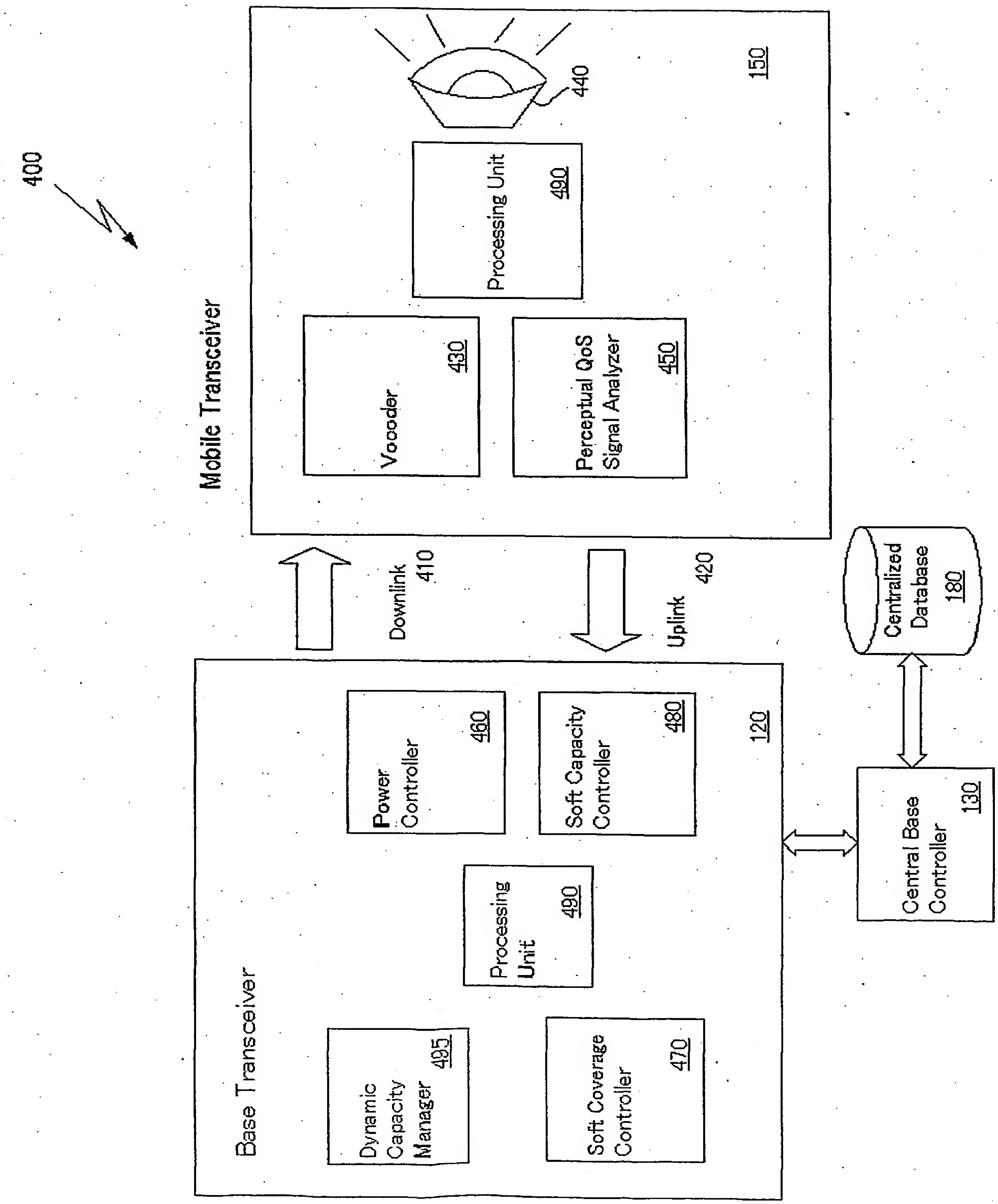

400
Mobile Transceiver
150
440
Processing Unit
490
Vocoder
430
Perceptual QoS
Signal Analyzer
450
Downlink
410
Uplink
420
Centralized
Database
180
Base Transceiver
120
Power
Controller
460
Soft Capacity
Controller
480
Processing
Unit
490
Dynamic
Capacity
Manager
495
Soft Coverage
Controller
470
Central Base
Controller
130

FIG.5

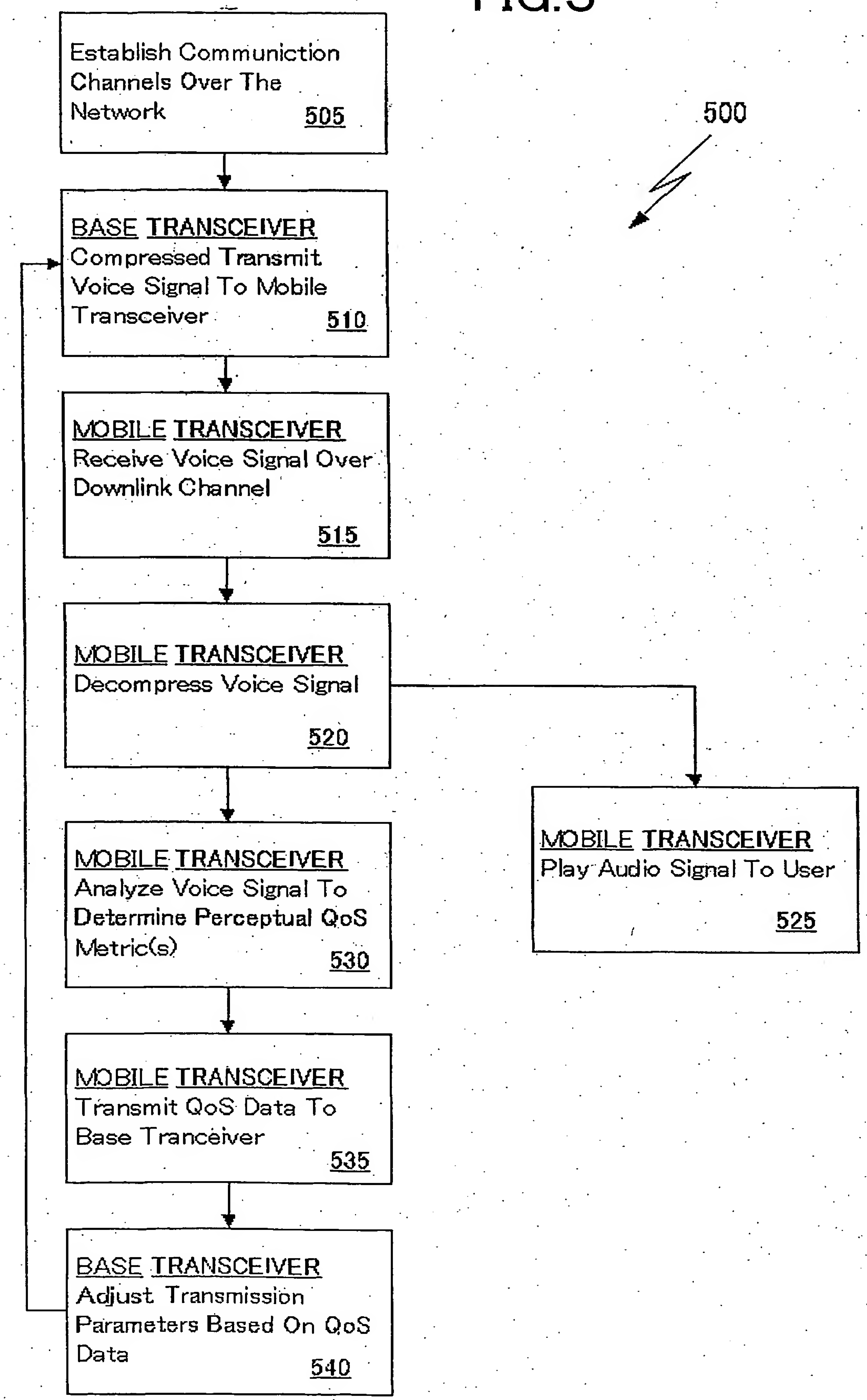

Establish Communiction Channels Over The Network 505
BASE TRANSCEIVER Compressed Transmit Voice Signal To Mobile Transceiver 510
MOBILE TRANSCEIVER Receive Voice Signal Over Downlink Channel 515
MOBILE TRANSCEIVER Decompress Voice Signal 520
MOBILE TRANSCEIVER Play Audio Signal To User 525
MOBILE TRANSCEIVER Analyze Voice Signal To Determine Perceptual QoS Metric(s) 530
MOBILE TRANSCEIVER Transmit QoS Data To Base Tranceiver 535
BASE TRANSCEIVER Adjust Transmission Parameters Based On QoS Data 540
500

FIG.6

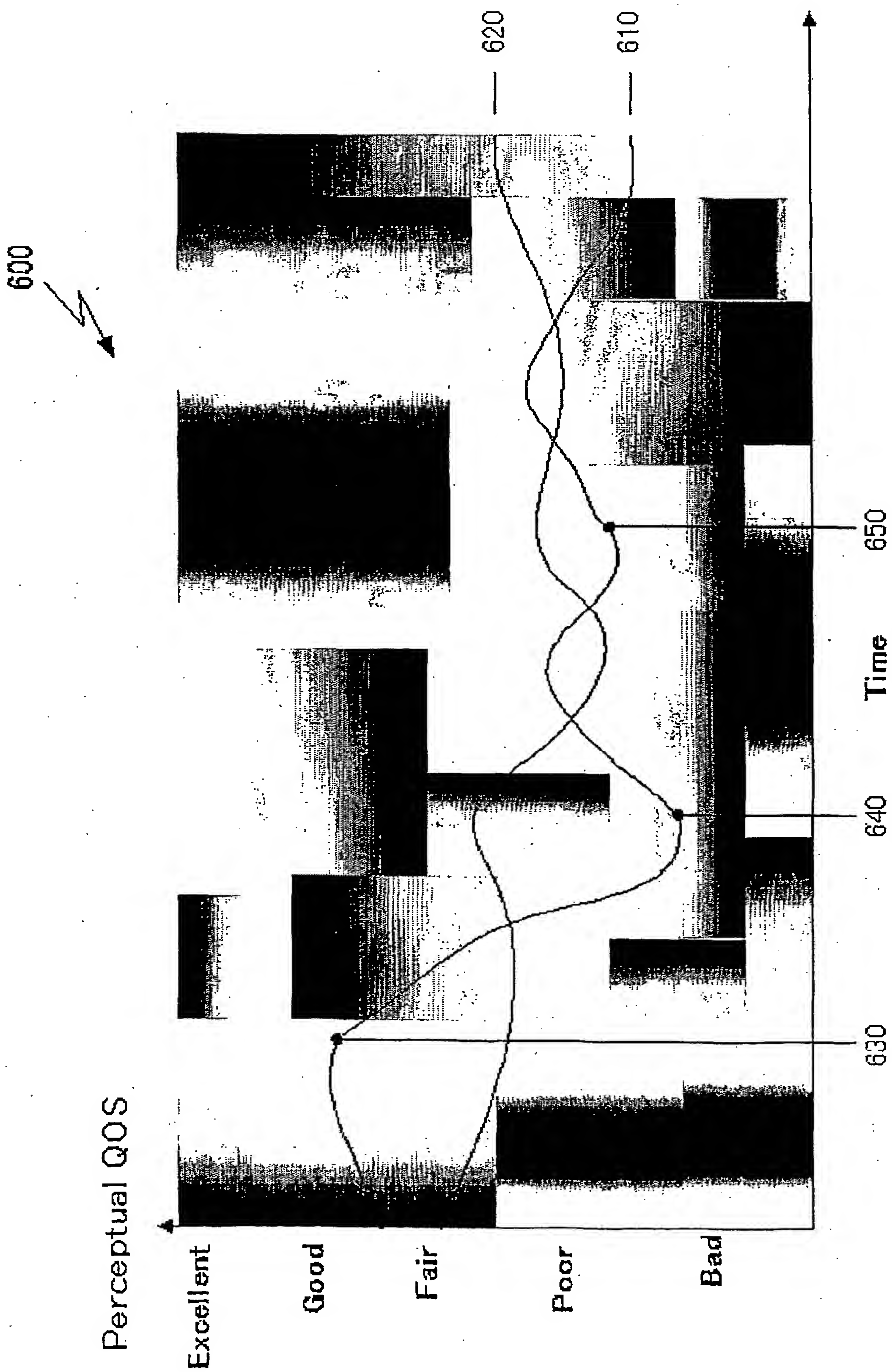

600
620
610
650
640
630
Time
Perceptual QOS
Excellent
Good
Fair
Poor
Bad

FIG.7

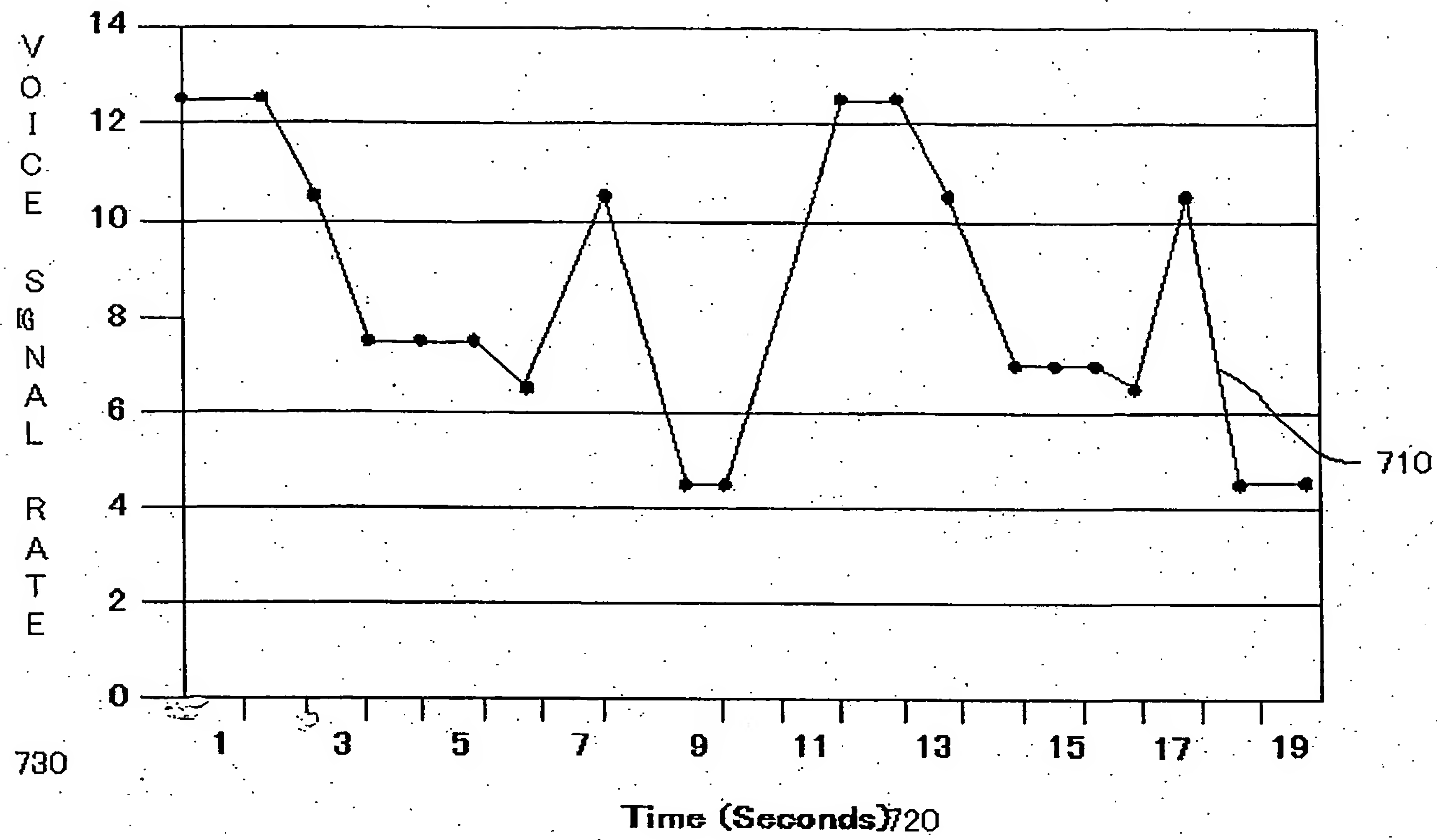

VOICE SIGNAL RATE
14
12
10
8
6
4
2
0
1
3
5
7
9
11
13
15
17
19
710
730
Time (Seconds)
720

FIG.8

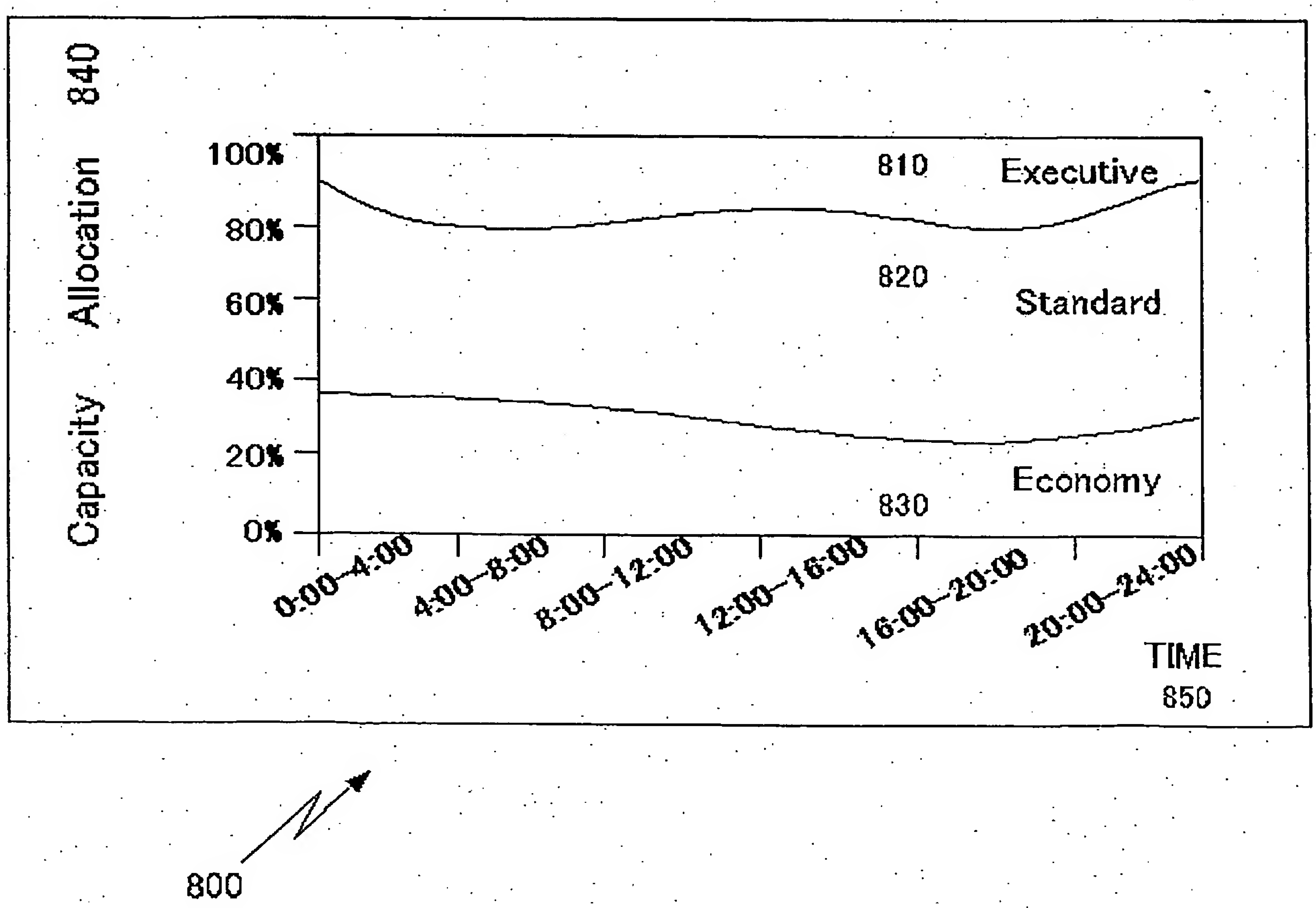
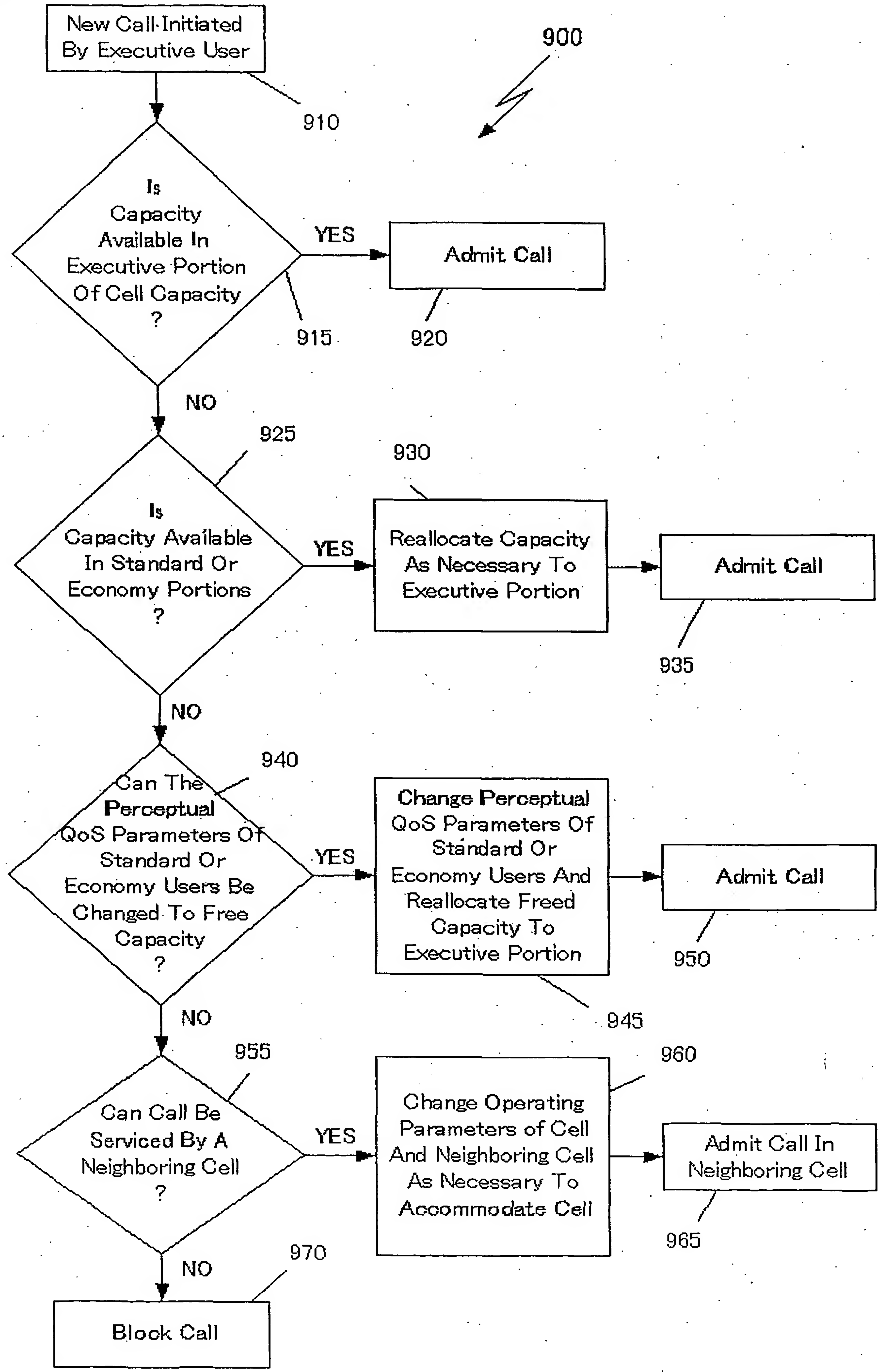

Capacity Allocation 840
100%
80%
60%
40%
20%
0%
810
Executive
820
Standard
830
Economy
0:00-4:00
4:00-8:00
8:00-12:00
12:00-16:00
16:00-20:00
20:00-24:00
TIME
850
800

FIG.9



900
New Call Initiated By Executive User
910
Is Capacity Available In Executive Portion Of Cell Capacity ?
915
YES
Admit Call
920
NO
Is Capacity Available In Standard Or Economy Portions ?
925
YES
Reallocate Capacity As Necessary To Executive Portion
930
Admit Call
935
NO
Can The Perceptual QoS Parameters Of Standard Or Economy Users Be Changed To Free Capacity ?
940
YES
Change Perceptual QoS Parameters Of Standard Or Economy Users And Reallocate Freed Capacity To Executive Portion
945
Admit Call
950
NO
Can Call Be Serviced By A Neighboring Cell ?
955
YES
Change Operating Parameters of Cell And Neighboring Cell As Necessary To Accommodate Cell
960
Admit Call In Neighboring Cell
965
NO
Block Call
970

FIG.10

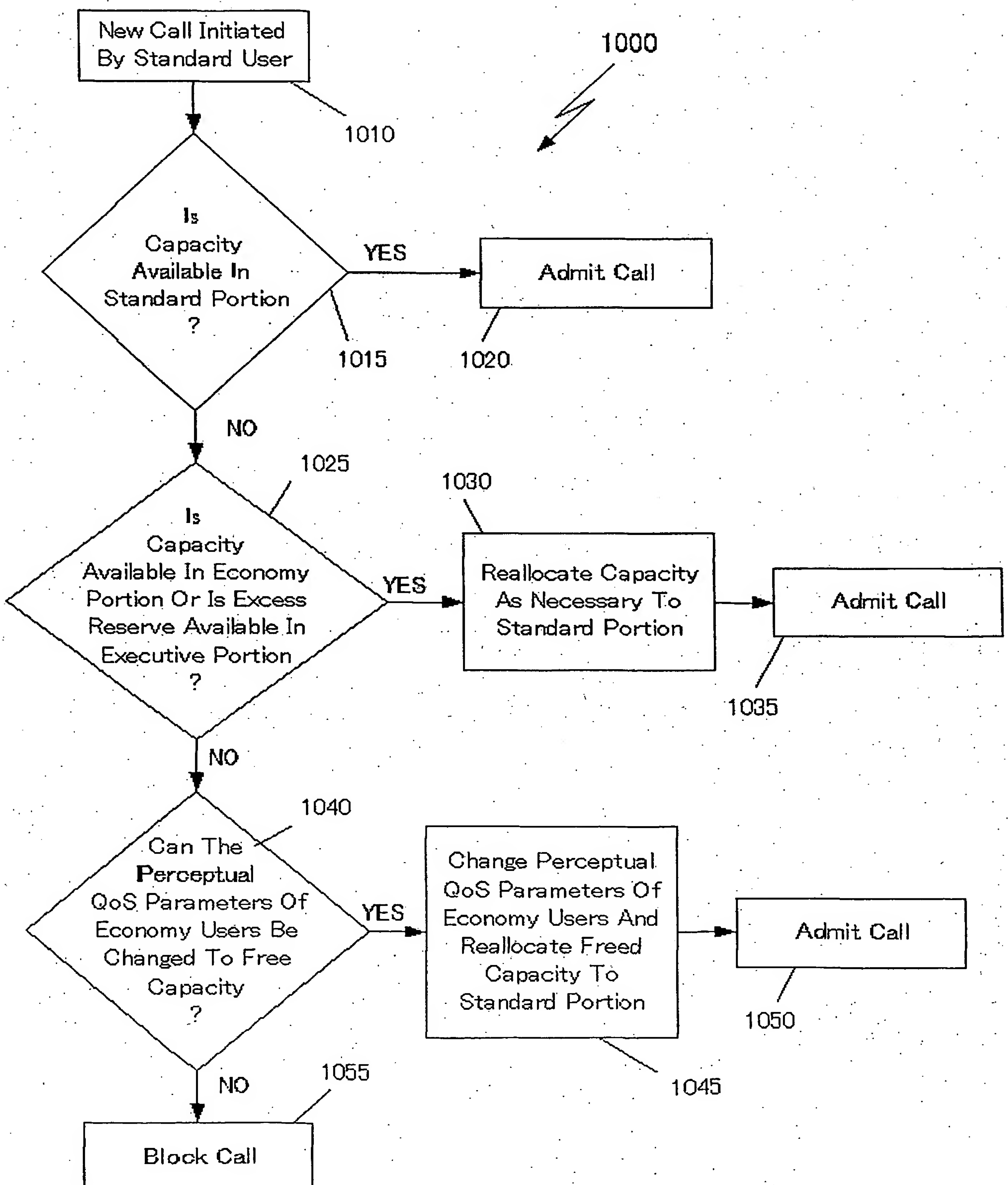
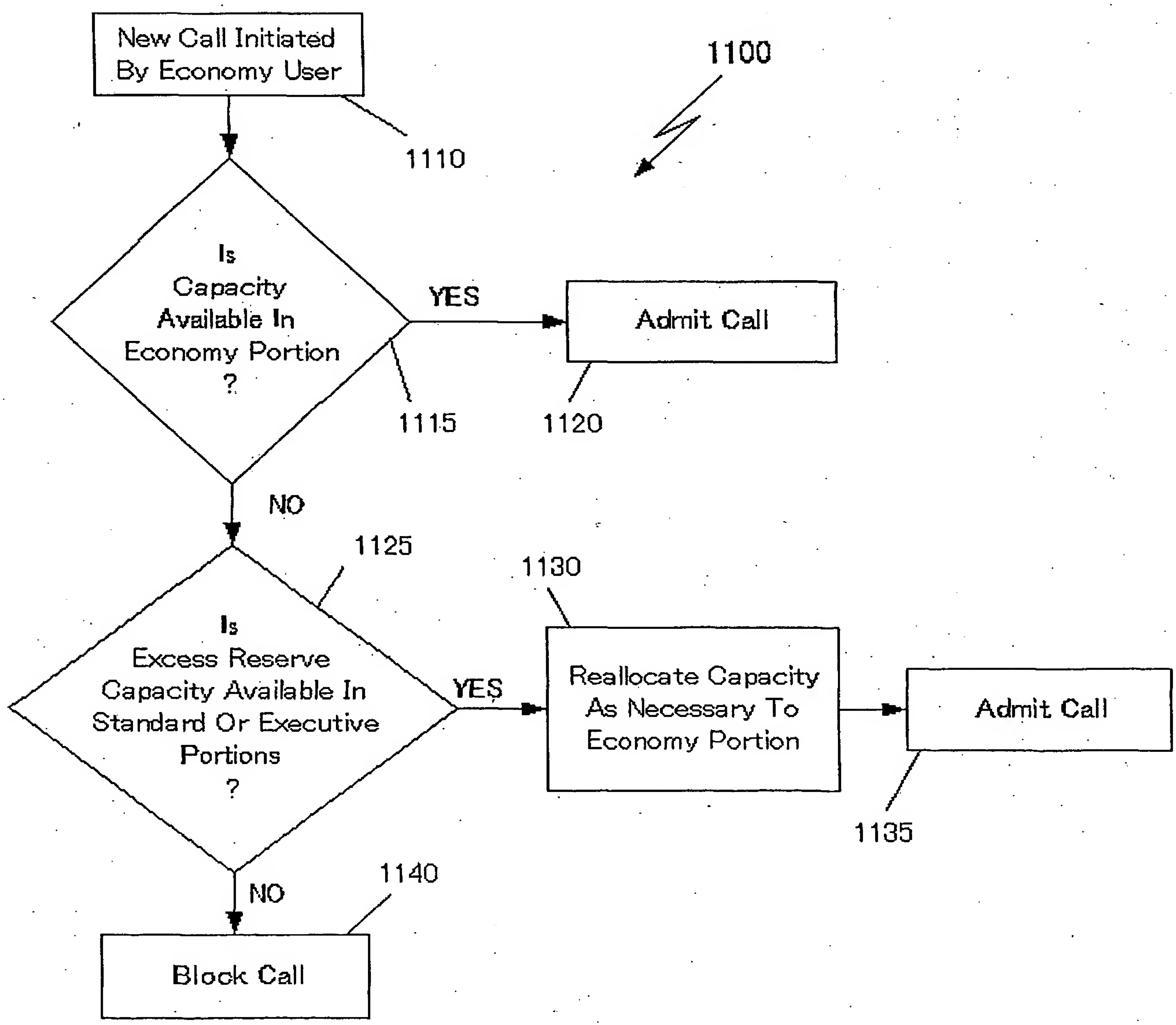

New Call Initiated By Standard User
1000
1010
Is Capacity Available In Standard Portion ?
YES
Admit Call
1015
1020
NO
1025
1030
Is Capacity Available In Economy Portion Or Is Excess Reserve Available In Executive Portion ?
YES
Reallocate Capacity As Necessary To Standard Portion
Admit Call
1035
NO
1040
Can The Perceptual QoS Parameters Of Economy Users Be Changed To Free Capacity ?
YES
Change Perceptual QoS Parameters Of Economy Users And Reallocate Freed Capacity To Standard Portion
Admit Call
1050
NO
1055
1045
Block Call

FIG.11



Docket # 2003P16583
Applic. #
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